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(54) **MULTI-POINT LOCKING SYSTEM AND ASTRAGAL**

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(73) Assignee: **Endura Products, Inc.**, Colfax, NC (US)

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Related U.S. Application Data

(62) Division of application No. 12/390,976, filed on Feb. 23, 2009, now Pat. No. 8,157,298.

(51) **Int. Cl.**

E01F 13/00	(2006.01)
E05C 9/18	(2006.01)
E05B 63/24	(2006.01)
E05C 7/04	(2006.01)
E05B 15/02	(2006.01)

(52) **U.S. Cl.**

CPC ***E05C 9/185*** (2013.01); ***E05B 63/242*** (2013.01); ***E05C 7/04*** (2013.01); ***E05C 9/1891*** (2013.01); *E05B 15/0245* (2013.01); *E05B 2015/027* (2013.01); *E05C 7/045* (2013.01); *E05C 9/1808* (2013.01); *Y10T 70/5372* (2015.04); *Y10T 292/0834* (2015.04); *Y10T 292/0837* (2015.04); *Y10T 292/0895* (2015.04); *Y10T 292/0967* (2015.04); *Y10T 292/1077* (2015.04); *Y10T 292/696* (2015.04)

(58) **Field of Classification Search**

CPC E05B 15/0245; E05B 2015/027; E05B 63/242

USPC 70/107; 292/341.17; 49/367

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

618,305	A		1/1899	Weaver
826,943	A		6/1906	Gilleland
1,077,433	A		11/1913	Schlis
2,586,900	A		2/1952	Alderman
2,610,368	A		9/1952	Tschaepe
3,211,850	A	*	10/1965	Toepfer 200/61.64

(Continued)

OTHER PUBLICATIONS

Official Action issued Oct. 28, 2011, (CA App. No. 2,693,833, filed Feb. 19, 2010), pp. 1-3.

(Continued)

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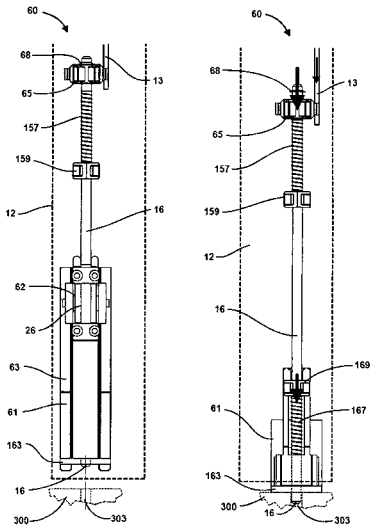
(57) **ABSTRACT**

A multipoint locking system includes a body having an upper aperture and a lower aperture therein. An upper latch pawl is disposed in the upper aperture and is pivotable about a first vertical axis between a first retracted position and a first extended position. A lower latch pawl is disposed in the lower aperture and is pivotable about a second vertical axis between a second retracted position and a second extended position. At least one actuator is configured to move the upper and lower latch pawls between their retracted and extended positions. The body can be an astragal, a vertical frame member, or the like.

10 Claims, 16 Drawing Sheets



(56) **References Cited**

U.S. PATENT DOCUMENTS

3,638,984	A		2/1972	Davidson
3,649,060	A		3/1972	Ruff
3,656,788	A		4/1972	Emery
3,788,679	A		1/1974	Banham
3,788,687	A		1/1974	Zawadzki
4,428,153	A	*	1/1984	Klinger et al. 49/366
4,429,493	A		2/1984	St. Aubin
4,644,696	A		2/1987	Bursk
4,999,950	A		3/1991	Beske
5,197,771	A		3/1993	Kaup
5,290,077	A		3/1994	Fleming
5,328,217	A	*	7/1994	Sanders 292/341.19
5,350,207	A	*	9/1994	Sanders 292/335
5,524,942	A		6/1996	Fleming
5,590,919	A		1/1997	Germano
5,782,114	A		7/1998	Zeus
5,791,700	A		8/1998	Biro
5,857,291	A		1/1999	Headrick
5,906,403	A		5/1999	Bestler
6,009,732	A		1/2000	Haeck
6,131,966	A	*	10/2000	Hensley et al. 292/139
6,282,929	B1		9/2001	Eller et al.
6,457,751	B1		10/2002	Hartman
6,491,326	B1		12/2002	Massey et al.
6,874,830	B2		4/2005	Bashford
6,966,585	B2		11/2005	Egi et al.
6,971,686	B2		12/2005	Becken
7,036,854	B1		5/2006	Lai
7,144,053	B2		12/2006	Bashford
7,267,379	B2		9/2007	Rusiana
7,641,244	B2		1/2010	Lin
7,669,902	B2		3/2010	Orbeta
7,722,097	B2		5/2010	Schnarr et al.
7,735,882	B2	*	6/2010	Abdollahzadeh et al. 292/44
7,752,875	B2		7/2010	Constantinou et al.
7,900,981	B2		3/2011	Hirschoff
7,942,458	B2		5/2011	Patterson
2005/0120631	A1	*	6/2005	Sanders 49/367
2006/0145488	A1		7/2006	Wittke et al.
2007/0001469	A1		1/2007	Balbo Di Vinadio
2007/0029812	A1		2/2007	Monts de Oca
2007/0283629	A1		12/2007	Phipps
2008/0087052	A1		4/2008	Abdollahzadeh et al.

OTHER PUBLICATIONS

Official Action issued Oct. 17, 2011, (U.S. Appl. No. 12/895,432, filed Sep. 30, 2010), pp. 1-8.

* cited by examiner

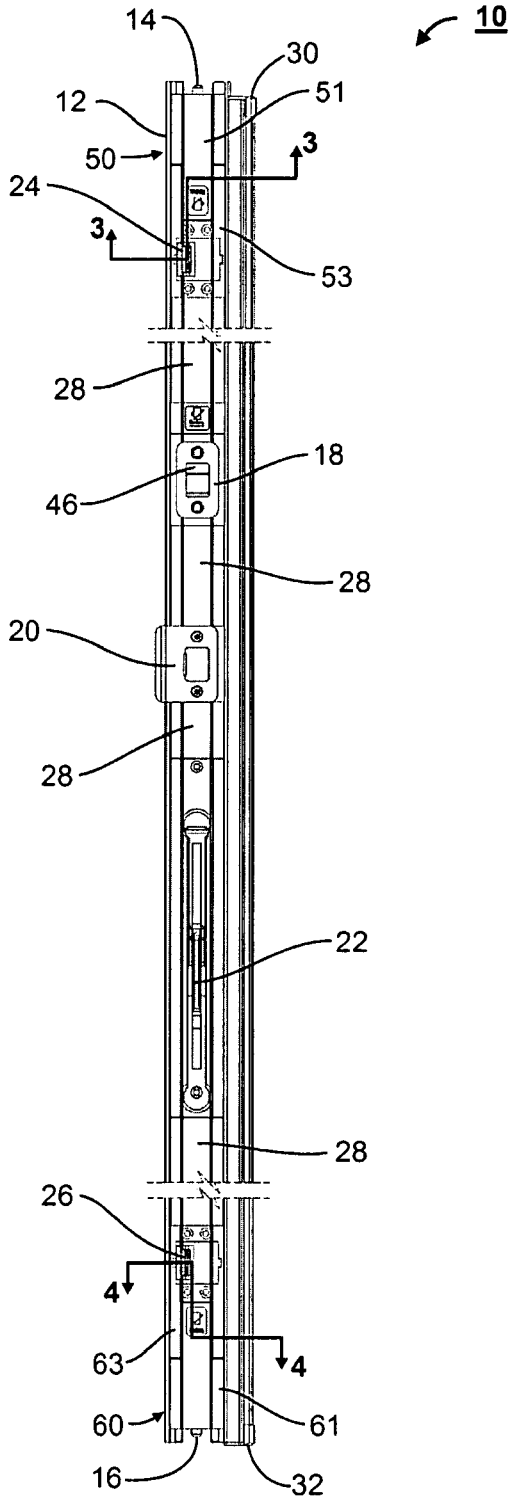


Fig. 1

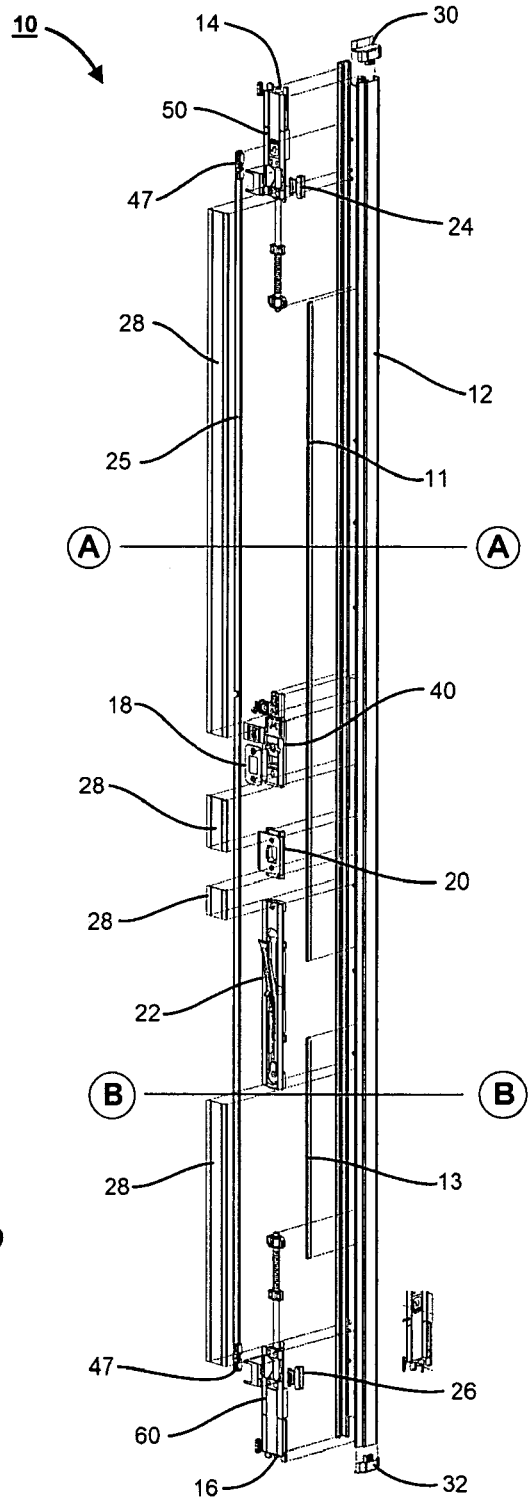

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Fig. 2

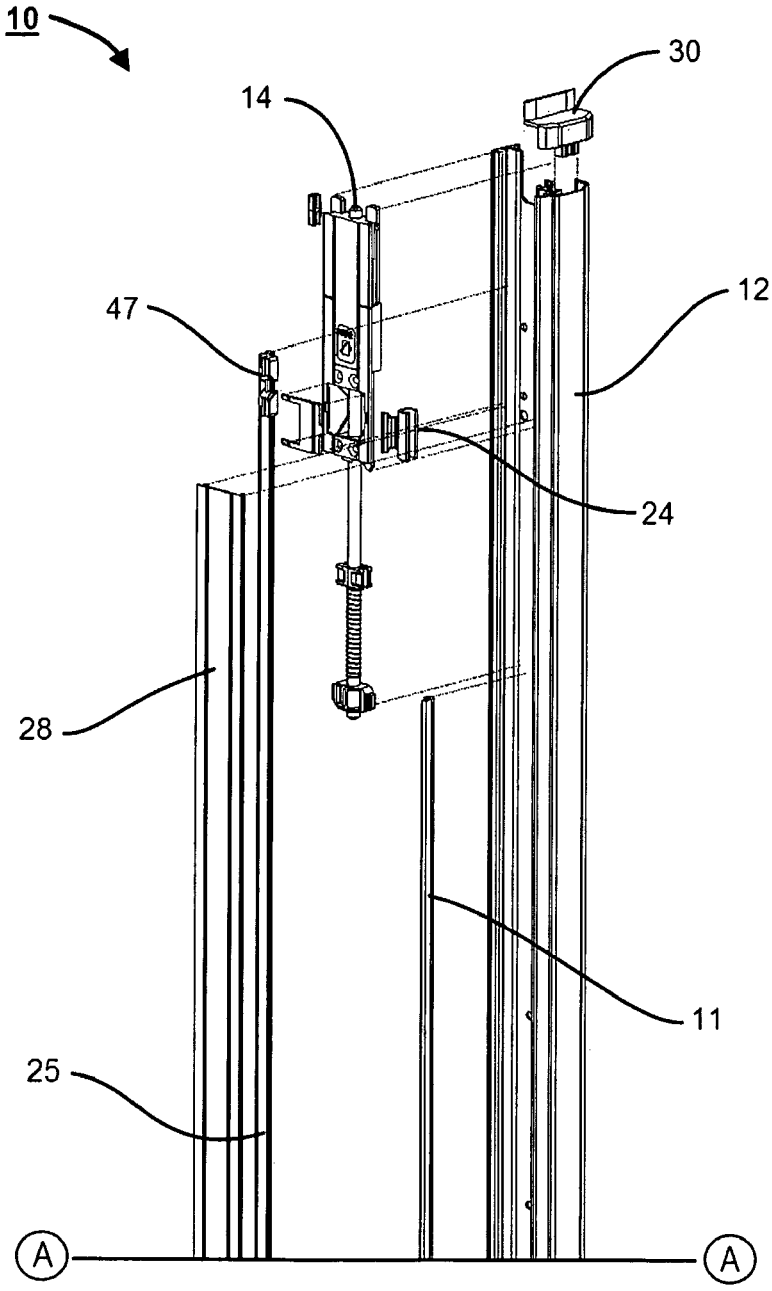
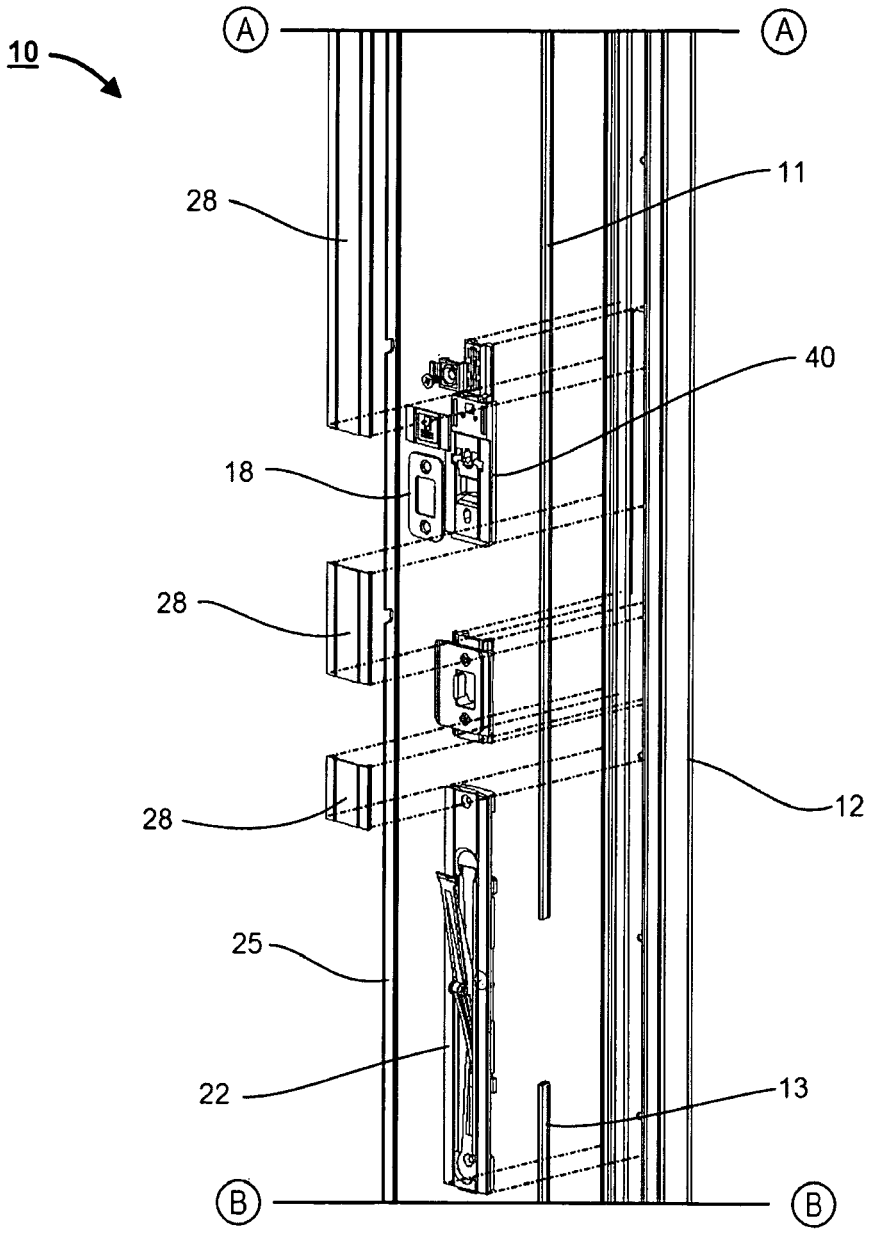


Fig. 2A



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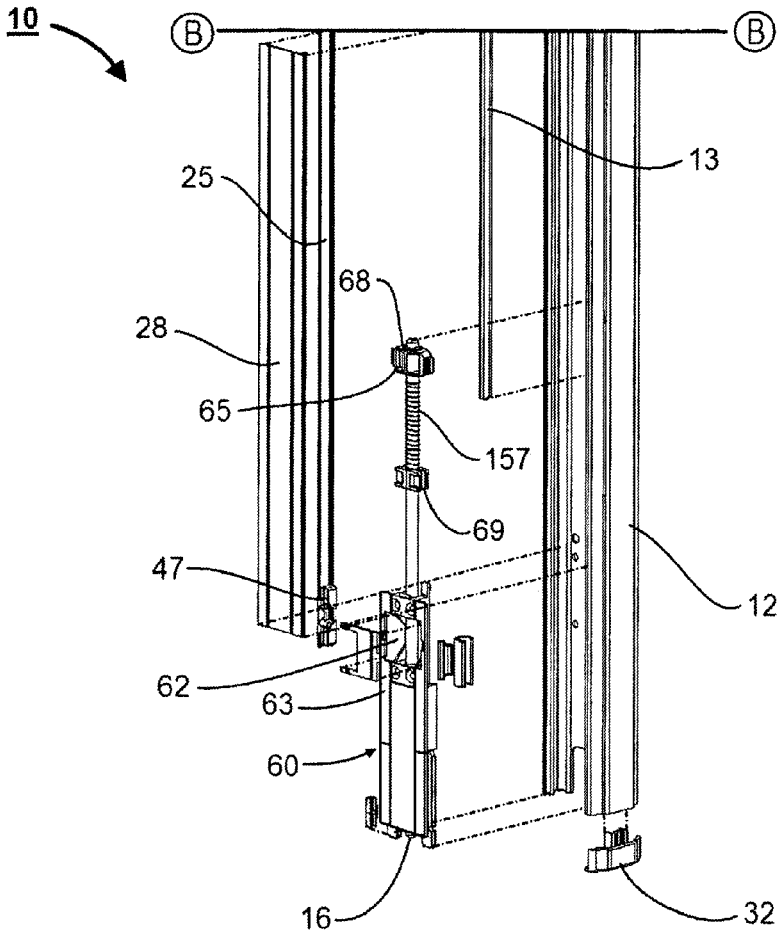

Fig. 2C

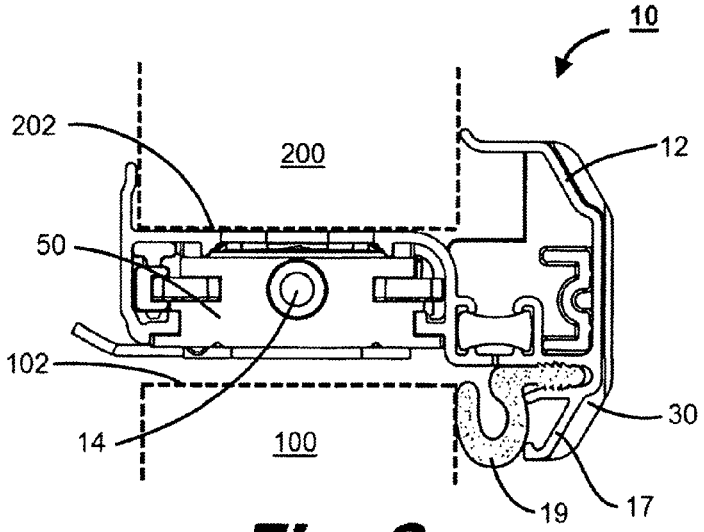
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Fig. 3

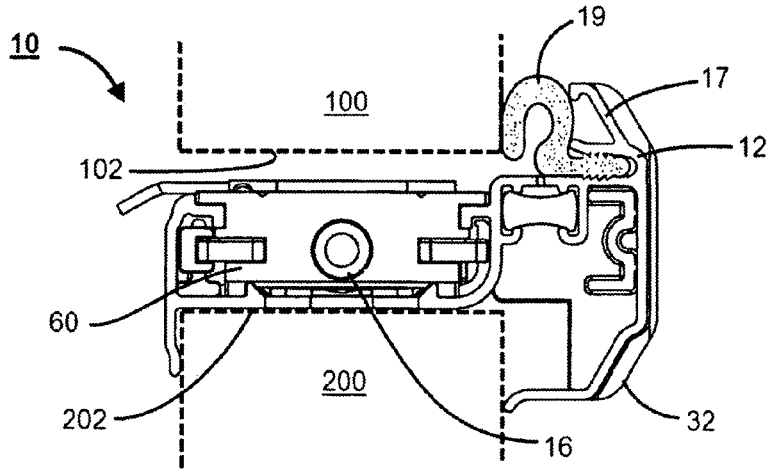
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Fig. 4

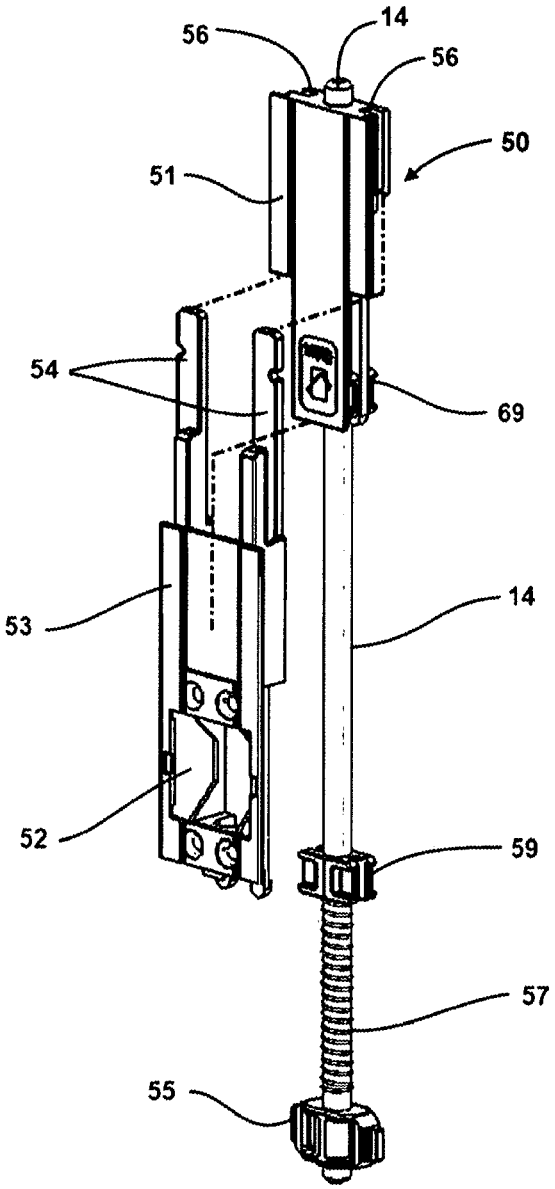


Fig. 5

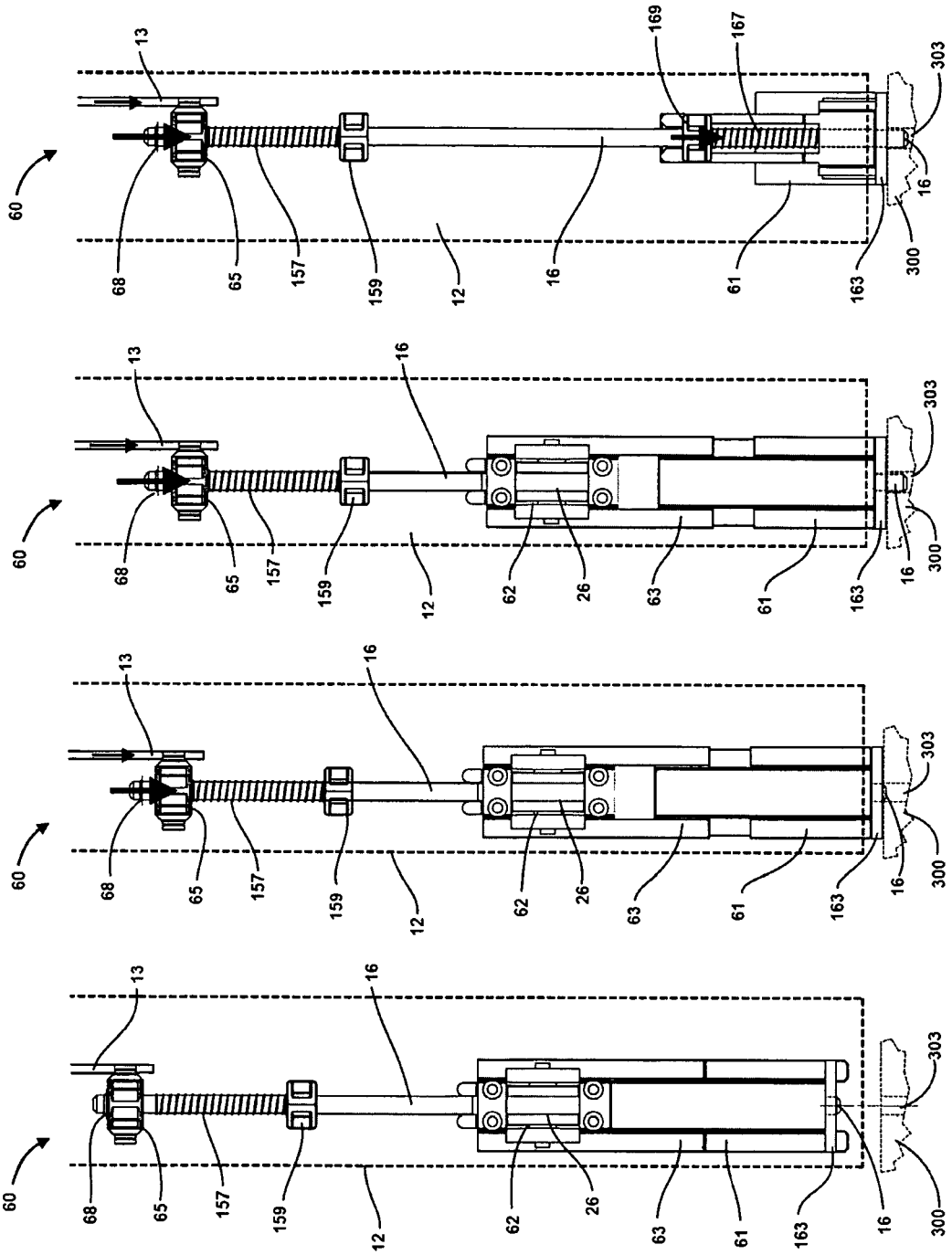
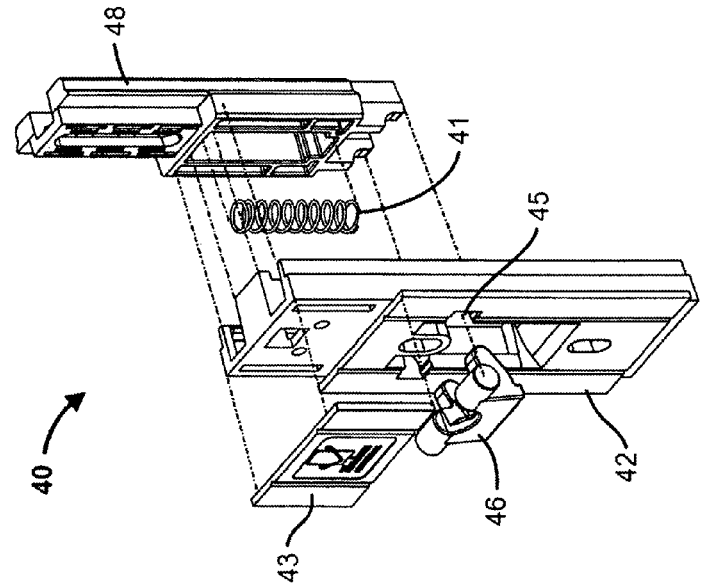


Fig. 6D

Fig. 6C

Fig. 6B

Fig. 6A



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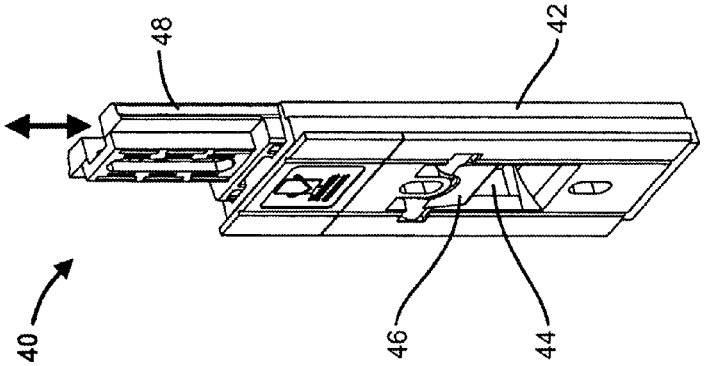

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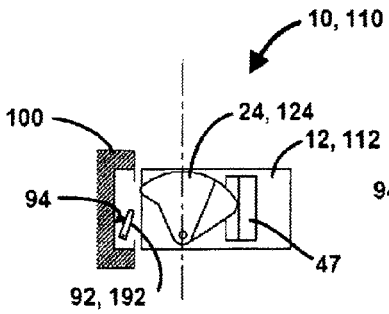

Fig. 9B

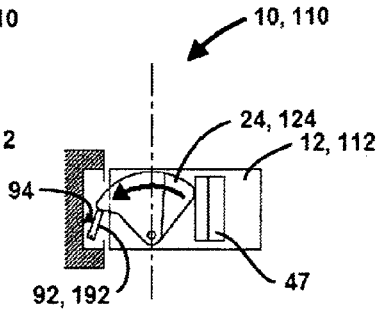

Fig. 10B

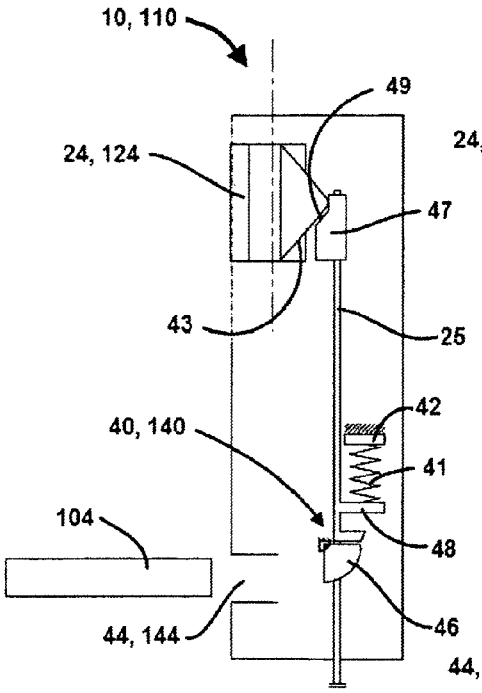

Fig. 9A

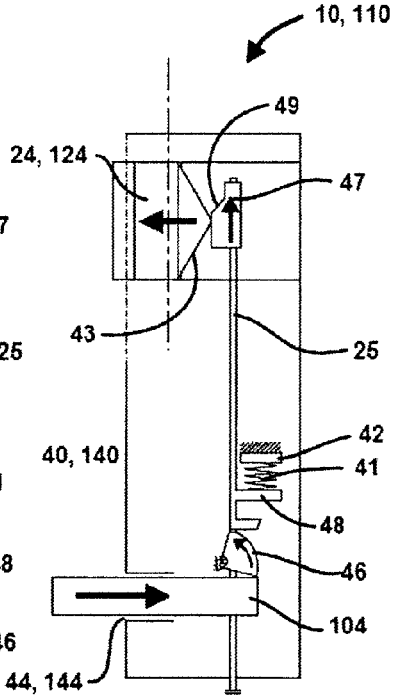

Fig. 10A

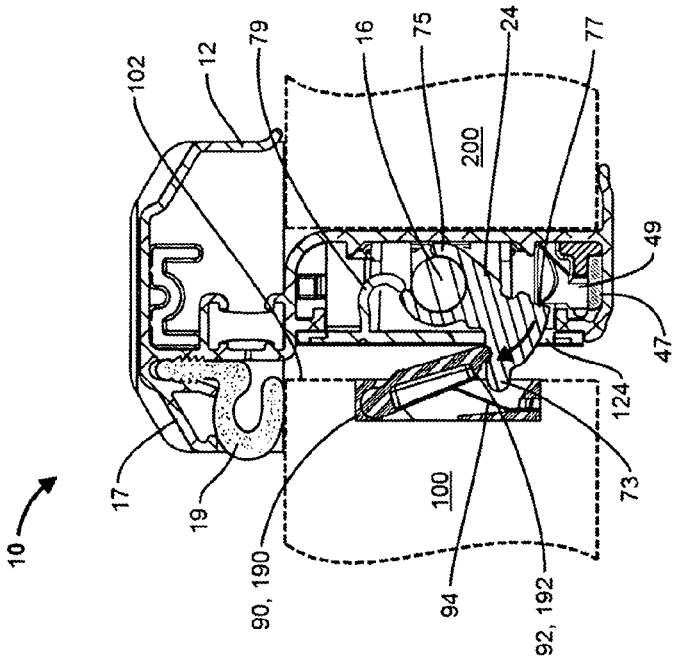

Fig. 11B

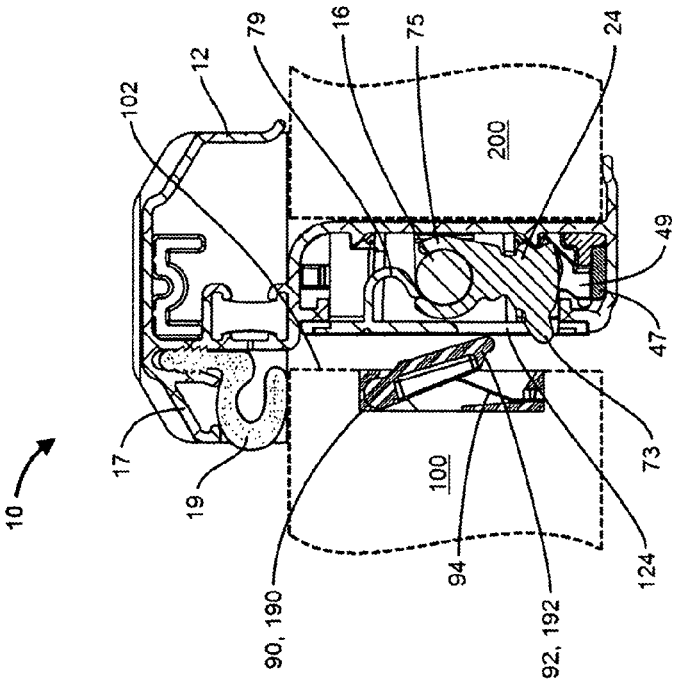

Fig. 11A

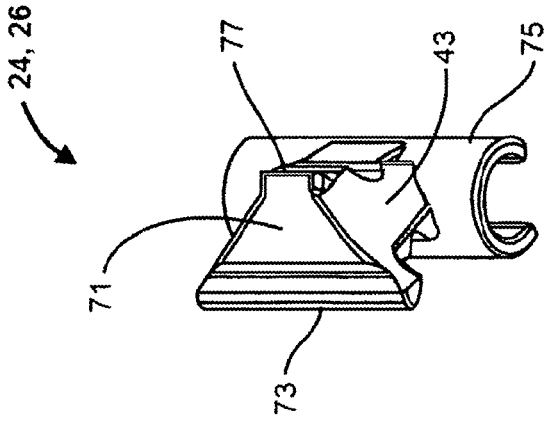

Fig. 13

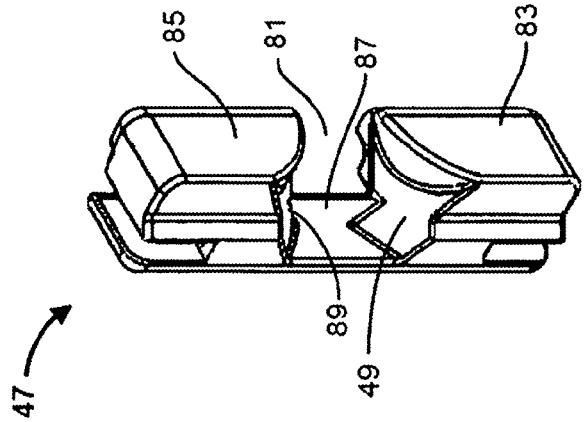

Fig. 12

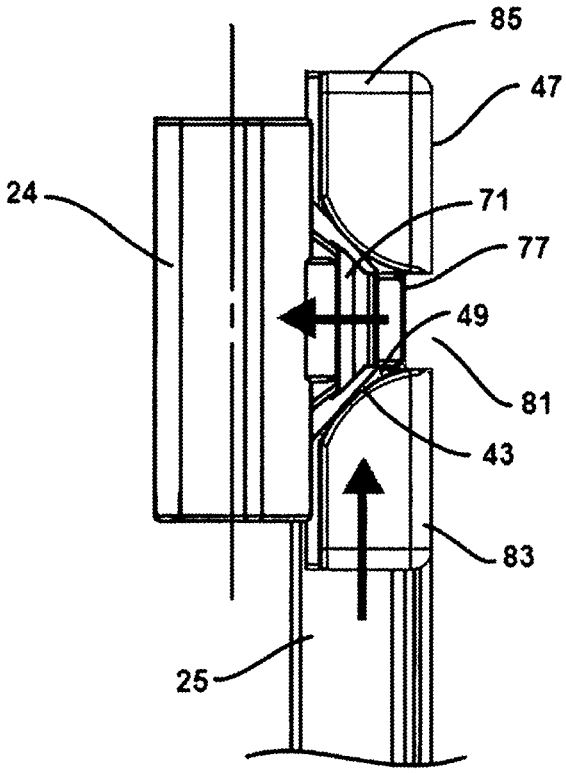

Fig. 14

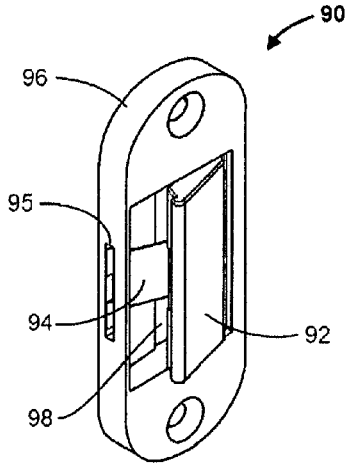

Fig. 15

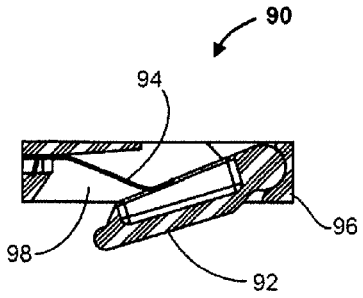

Fig. 16

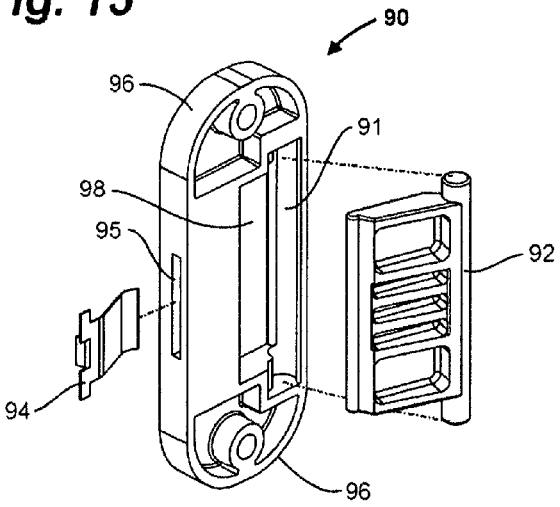

Fig. 17

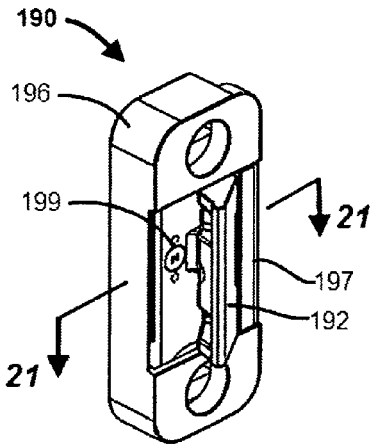

Fig. 18

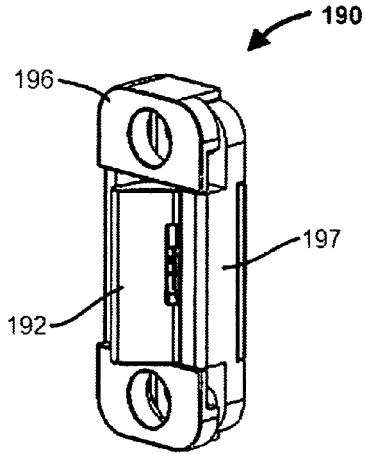

Fig. 19

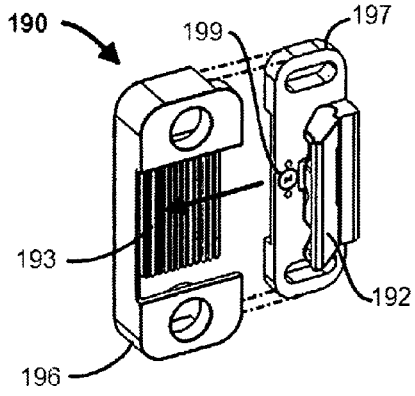

Fig. 20

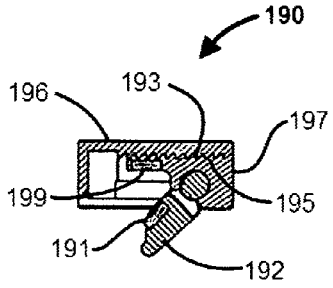

Fig. 21

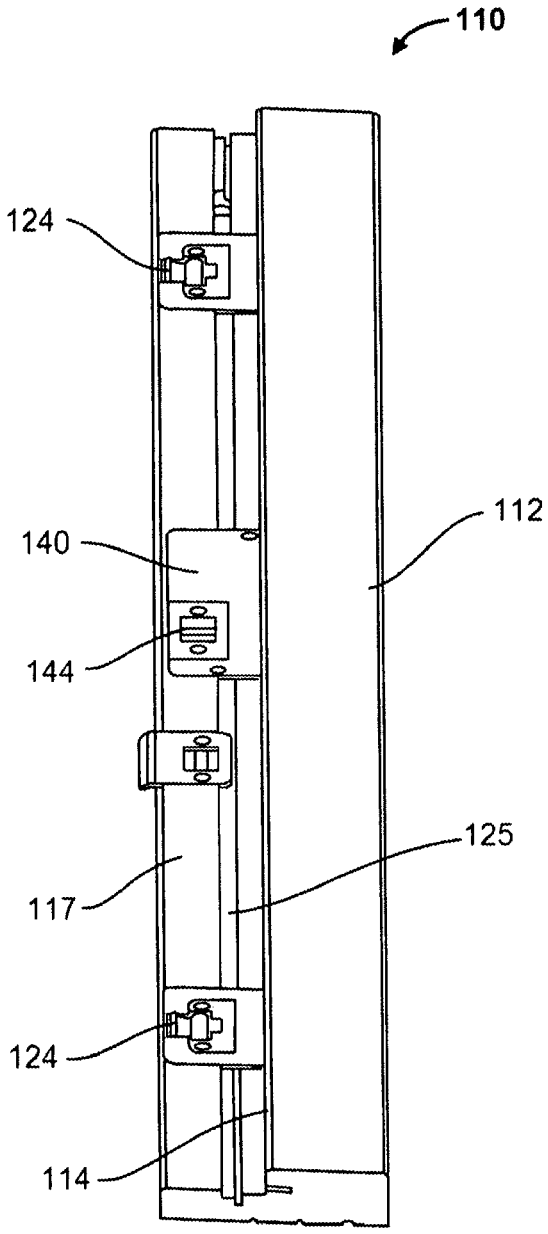

Fig. 22

MULTI-POINT LOCKING SYSTEM AND ASTRAGAL

RELATED APPLICATIONS

This application is a divisional of U.S. application Ser. No. 12/390,976 filed Feb. 23, 2009, the content of which is incorporated by reference in its entirety.

FIELD OF THE INVENTION

The invention generally relates to locks, and more particularly relates to a multi-point locking system for securing a swinging door panel in a closed position and an astragal incorporating such a multi-point locking system.

BACKGROUND

Exterior entryways of modern homes and buildings often include cooperating pairs of swinging doors commonly referred to as double doors or French doors. Such doors include an inactive swinging door panel, and an adjacent active swinging door panel. The sets of doors may swing inwardly into the structure (so-called "inswing" doors), or may swing outwardly from the structure (so-called "outswing" doors). The inactive door panel typically includes a generally T-shaped astragal mounted along the entire extent of its non-hinged vertical edge. As used herein, the term "astragal" generally means an elongated member attached to and substantially coextensive with the non-hinged vertical edge of one of a pair of swinging double doors. In a conventional arrangement, an astragal is mounted along the non-hinged vertical edge of an inactive door panel, and provides a stop against which a cooperating active door panel strikes when both door panels are closed.

In its simplest form, an astragal consists of a single length of wooden molding attached along the non-hinged edge of an inactive door panel by screws, nails, or the like. Such simple astragals serve no role in fixing an inactive swinging door panel in a closed position in a doorway. Instead, special unrelated locking hardware is required for that purpose. Such locking hardware can be internally mounted within specially formed pockets or recesses within the body of the inactive door panel. Such pockets or recesses must be specially formed in the edge of the door by routing, milling, chiseling, or the like. The locking hardware typically includes independently operable top and bottom shoot bolts which are received in specially drilled bores in the top and bottom of the inactive door panel proximate to the door panel's non-hinged vertical edge. When extended, the top and bottom shoot bolts selectively engage aligned pockets or holes in the top jamb and doorsill of the associated doorway, thereby fixing the inactive door panel in a closed position. When retracted, the top and bottom shoot bolts permit the inactive door panel to swing open. Both the top and bottom shoot bolts typically are actuated by either a slide or lever mechanism installed along the non-hinged vertical edge of the inactive door panel.

Some modern astragals for inactive door panels include vertically moveable top and bottom shoot bolts disposed in a flush-mounted elongated housing. One such astragal is described in U.S. Pat. No. 6,491,326 to Endura Products, Inc., for example. Like the simple astragal described above, the housing of such locking astragals is surface-mounted along the non-hinged vertical edge of an inactive door panel, and provides a stop for a cooperating active door panel. When the inactive panel is closed and the top and bottom shoot bolts are vertically extended, the top and bottom shoot bolts are respectively received in pockets or holes in the top jamb and doorsill of the associated doorway, thereby fixing the inactive panel in a closed position. In order to permit the inactive panel to be opened, the top and bottom shoot bolts can be selectively retracted from their associated pockets or holes in the doorframe. The top and bottom shoot bolts can be vertically extended and retracted by a lever or slide actuating mechanism disposed within the housing. Unlike shoot bolt mechanisms that must be internally installed within specially formed recesses or pockets in a door, such locking astragals can be removably installed relatively easily on a substantially planar external surface or surfaces of an inactive door panel.

The active door panel of a pair of double swinging doors commonly includes conventional locking door hardware. Such hardware may include a conventional door handle lockset like that used for a single swinging door. In such an arrangement, the latch bolt of the lockset is received in an aligned strike plate recess milled in the non-hinged vertical edge of the cooperating inactive door panel, or in an astragal attached along the non-hinged vertical edge of the cooperating inactive door panel. For added security, a conventional deadbolt also may be installed in the active door panel. Like the lockset bolt described above, the bolt of the deadbolt is received in an aligned strike plate recess milled in the non-hinged vertical edge of the cooperating inactive door panel or an associated astragal.

For further additional security and strength, multi-point locking systems are known that can be specially installed within the non-hinged vertical edge of an active door panel. In such an arrangement, a lock case is recessed within a specially milled lock case pocket in the non-hinged vertical edge of an active swinging door panel. The lock case encloses an actuating mechanism. Upper and lower actuating rods or bars upwardly and downwardly extend from the lock case to upper and lower latch bolt housings, respectively. The independent upper and lower latch bolt housings contain latch bolt mechanisms, and are recessed within specially formed latch bolt pockets or recesses in the non-hinged vertical edge of the active swinging door panel. Operation of the actuating mechanism causes selective vertical movement of the actuating rods or bars, which in turn cause a latch bolt to laterally extend and outwardly protrude from each latch bolt housing. When extended, each latch bolt engages a mating opening or recess in an adjacent frame member, inactive door panel, astragal, or the like, thereby securing the active door panel in a closed position. An elongated faceplate may be attached to the edge face of the vertical edge of the door to conceal portions of the mechanism that are recessed within the edge of the door. Preferably, the upper latch bolt is positioned proximate to a top of the door's vertical edge, and the lower latch bolt is positioned proximate to a bottom of the door's edge. Similar recessed devices are known that include vertically extending latch bolts. Multi-point latching systems of this type are known to provide a stronger, more secure closure than single-point locks positioned at or near the mid-height of a door. Unfortunately, such multi-point locks are difficult and costly to install due to the extensive preparation of the door edges required to assemble the recessed portions of the locking mechanisms in the doors.

Accordingly, there is a need for a surface-mounted multi-point locking system for the non-hinged vertical edge of an inactive swinging panel that includes multiple latches for securely engaging a cooperating swinging active door panel at multiple points along the edge of the active door. In addition, there is a need for such a surface-mounting locking device for an inactive panel of a pair of double swinging panels that also fixes the inactive panel within a frame. Fur-

thermore, there is a need for a multi-point locking device that provides the added security of known recessed multi-point door locking systems, but does not require expensive custom preparation of a door's edge in order to install the device. There also is a need for a multipoint locking system for single swinging door panels.

SUMMARY

In one embodiment, an astragal can include a first shoot bolt that is movable between a retracted position and an extended position. A seal block can be movable between a non-sealing position and a sealing position and can include a bolt passage therethrough. The first shoot bolt can be slidably disposed in the passage. An actuator can be configured to selectively move the first shoot bolt between the retracted position and the extended position and to selectively move the seal block between the non-sealing position and the sealing position. A first spring can be configured to bias the first bolt toward the extended position when the first shoot bolt is in the extended position. A second spring can be configured to bias the seal block toward the sealing position when the seal block is in the sealing position. A first force exerted by the first spring on the first shoot bolt can be greatest when the first bolt is in the extended position, and a second force exerted by the second spring on the seal block can be greatest when the seal block is in the sealing position.

In another embodiment, a multipoint locking system can include a body having an upper aperture and a lower aperture therein. An upper latch pawl can be disposed in the upper aperture and can be pivotable about a first vertical axis between a first retracted position and a first extended position. A lower latch pawl can be disposed in the lower aperture and can be pivotable about a second vertical axis between a second retracted position and a second extended position. At least one actuator can be configured to move the upper and lower latch pawls between their retracted and extended positions.

In a further embodiment, a latch keeper for use with a locking system having a cooperating latch pawl can include a base having an aperture therein. A keeper pawl can be pivotally disposed within the aperture and can be movable between an extended position and a retracted position. The keeper pawl can be configured for engagement with a catch portion of the cooperating latch pawl when the latch pawl is in an extended position.

In an additional embodiment, an astragal can include an elongated housing having an upper end and a lower end. The housing can be configured for external attachment along a non-hinged vertical edge of a swinging door panel. An upper shoot bolt can be slidably disposed in the housing proximate to the upper end, and can be movable between a retracted position and an extended position. A lower shoot bolt can be slidably disposed in the housing proximate to the lower end, and can be movable between a recessed position and a deployed position. An actuator can include a lever that is selectively movable between an unlocked position and a locked position, and can be operatively coupled to both the upper shoot bolt and the lower shoot bolt. When the lever is in the unlocked position, the upper shoot bolt can be in its retracted position and the lower shoot bolt can be in its recessed position, and when the lever is in the locked position, the upper shoot bolt can be in its extended position and the lower shoot bolt can be in its deployed position.

In another embodiment, a multipoint locking system can be provided for a door panel having a non-hinged vertical edge and that is pivotally disposed within a doorframe having a vertical frame member that is proximate to the non-hinged vertical edge when the door panel is in a closed position in the doorframe. The locking system can include an upper latch pawl that is disposed in an upper aperture in the vertical frame member and that is pivotable about a first vertical axis between a first retracted position and a first extended position. The locking system also can include a lower latch pawl that is disposed in a lower aperture in the vertical frame member and that is pivotable about a second vertical axis between a second retracted position and a second extended position. An actuator can be operatively coupled to both the upper and lower latch pawls and can be configured to substantially simultaneously move the upper and lower latch pawls between their retracted and extended positions.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is an elevation view of one embodiment of a multi-point locking astragal assembly according to the invention.

FIG. **2** is an exploded view of the multi-point locking astragal assembly shown in FIG. **1**.

FIG. **2**A is a detail view of an upper portion of the exploded assembly shown in FIG. **2**.

FIG. **2**B is a detail view of a middle portion of the exploded assembly shown in FIG. **2**.

FIG. **2**C a detail view of a lower portion of the exploded assembly shown in FIG. **2**.

FIG. **3** is a cross sectional view of an upper portion of the multi-point locking astragal assembly taken along offset section line **3**-**3** in FIG. **1**.

FIG. **4** is a cross sectional view of a lower portion of the multi-point locking astragal assembly taken along offset section line **4**-**4** in FIG. **1**.

FIG. **5** is an exploded perspective view of one embodiment of an upper shoot bolt assembly.

FIG. **6**A is an elevation view of a lower shoot bolt assembly with its shoot bolt in a retracted position.

FIG. **6**B is an elevation view of a lower shoot bolt assembly with its shoot bolt in a partially extended position.

FIG. **6**C is an elevation view of a lower shoot bolt assembly with its shoot bolt in a fully extended position.

FIG. **6**D is an elevation view of the opposite side of the lower shoot bolt assembly shown in FIG. **6**C.

FIG. **7** is a perspective view of one embodiment of a multi-point latch actuator assembly.

FIG. **8** is an exploded perspective view of the multi-point latch actuator assembly shown in FIG. **7**.

FIG. **9**A is a schematic elevation view of one embodiment of a multi-point latch mechanism in an unlocked position.

FIG. **9**B is a top plan view of the multi-point latch mechanism shown in FIG. **9**A.

FIG. **10**A is a schematic diagram of the multi-point latch mechanism shown FIGS. **9**A and **9**B showing the mechanism in a locked position.

FIG. **10**B is a top plan view of the multi-point latch mechanism shown in FIG. **10**A.

FIG. **11**A is a cross-sectional view taken through the upper latch of a multi-point locking system with the latch in an unlocked position.

FIG. **11**B is a cross-sectional view taken through the upper latch of a multi-point locking system with the latch in a locked position.

FIG. **12** is a perspective view of a latch actuation member for use in a multi-point locking system.

FIG. **13** is a perspective view of a latch pawl for use in a multi-point locking system.

FIG. **14** is an elevation view showing a latch pawl engaged with a latch actuation member in a multi-point locking system.

FIG. **15** is a perspective view of one embodiment of a latch keeper for use with a multi-point locking system.

FIG. **16** is a cross-sectional view of the latch keeper shown in FIG. **15**.

FIG. **17** is an exploded perspective view of the latch keeper shown in FIG. **15**.

FIG. **18** is a perspective view of a second embodiment of a latch keeper for use with a multi-point locking system.

FIG. **19** is another perspective view of the second embodiment of a latch keeper shown in FIG. **18**.

FIG. **20** is an exploded perspective view of the latch keeper shown in FIGS. **18** and **19**.

FIG. **21** is a cross sectional view of the latch keeper shown in FIGS. **18-20** taken along line **21-21** in FIG. **18**.

FIG. **22** is perspective view of a door frame member having a multi-point locking system.

DESCRIPTION

One embodiment of a surface-mounting multi-point locking astragal **10** for an inactive door panel is shown in FIGS. **1-4**. As shown in FIG. **1**, the astragal **10** can include an elongated body **12** having an upper shoot bolt **14** disposed at an upper end and a lower shoot bolt **16** disposed at a lower end. A shoot bolt actuator **22** can be provided for selectively extending and retracting the shoot bolts **14**, **16**. In the embodiment shown in the drawings, the shoot bolt actuator **22** is a lever-type actuator of a type known in the art. A strike plate **20** can be positioned along the astragal **10** to receive a door knob latch bolt from a cooperating active door panel (not shown). The astragal **10** can also include a dead bolt plate **18** for receiving a deadbolt from a cooperating active door panel. A plurality of body trim plates **28** can be provided between the various components. The astragal **10** also can include an upper multi-point latch pawl **24** positioned along an upper portion of the body **12** and a lower multi-point latch pawl **26** positioned along a lower portion of the body **12**.

Further details of the astragal **10** can be seen in the exploded views shown in FIGS. **2**, **2**A and **2**B. An upper trim cap **30** can be provided on the upper end of the body **12**, and a lower trim cap **32** can be provided on the lower end of the body **12**. The trim caps **30**, **32** provide the ends of the astragal **10** with a finished appearance. As shown in FIGS. **2** and **2**A, the upper shoot bolt **14** can be disposed within an upper shoot bolt assembly **50**. Similarly, the lower shoot bolt **16** can be disposed within a lower shoot bolt assembly **60**. As shown in FIG. **2**, the upper and lower shoot bolt assemblies **50**, **60** can be respectively connected to the shoot bolt actuator **22** by upper and lower shoot bolt actuator links **11**, **13**. As shown in FIGS. **2** and **2**B, a multi-point latch actuator assembly **40** can be disposed behind the dead bolt plate **18**. One or more push rods **25** can operably connect the upper and lower latch pawls **24**, **26** to the multi-point latch actuator **40**. As described below, the multi-point latch actuator **40** can be configured to simultaneously extend the upper and lower multi-point latch pawls **24**, **26** when a deadbolt from a cooperating swinging door panel is received in the dead bolt plate **14** and the actuator **40**.

FIGS. **3** and **4** show a cross-sectional profile of one embodiment of an astragal **10** having a body **12**. The body **12** can be configured for attachment along a non-hinged vertical edge **202** of an inactive door panel **200**. An outwardly extending edge portion **17** of the body **12** provides a stop for a cooperating active door panel **100**. A resilient seal **19** can be attached along the edge portion **17** to provide a weather seal between the astragal **10** and an associated swinging active panel **100**.

One embodiment of an upper shoot bolt assembly **50** is shown in FIG. **5**. In this embodiment, the upper shoot bolt **14** can be slidably received in a sliding upper seal block **51** having opposed grooves **56**. The opposed grooves **56** can each receive a track **54** on an upper guide **53** when the upper seal block **51** is slidably engaged with the upper guide **53**. The upper guide **53** can be configured to be mounted within the astragal body **12** in a stationary position, and can include a latch opening **52**. As shown in FIG. **5**, an upper spring stop **69** and a lower spring stop **59** can be attached to the upper shoot bolt **14**. A push sleeve **55** can be slidably received on a lower end of the upper shoot bolt **14**, and a first spring **57** can be disposed between the lower spring stop **59** and the push sleeve **55**. Similarly and as shown in FIGS. **6**A-**6**D, the lower shoot bolt assembly **60** can include a lower guide **63** with a latch opening **62** and a sliding lower seal block **61**. A lower spring stop **169** and an upper spring stop **159** can be attached to the lower shoot bolt **14**. A push sleeve **65** can be slidably received on an upper end of the lower shoot bolt **16**, and a first spring **157** can be disposed between the upper spring stop **159** and the push sleeve **65**. As shown in FIGS. **2**A and **6**D, a second spring **167** can be disposed between the upper spring stop **169** and the lower seal block **61**. A retainer ring **68** on the upper end of the lower shoot bolt **16** can retain the push sleeve **65** on the lower shoot bolt **16**. A resilient seal **163** can be attached to a lower end of the lower seal block **61**. The upper shoot bolt assembly **50** and the lower shoot bolt assembly **60** can be substantially identical to each other or mirror images of each other.

Operation of a lower shoot bolt assembly **60** is illustrated in FIGS. **6**A-**6**D. Operation of the upper shoot bolt assembly **50** can be substantially the same. In FIGS. **6**A-**6**D, the resilient seal **163** is disposed on the bottom end of the seal block **61** and surrounds the lower shoot bolt **16**. The seal **163** can be constructed of a resilient material such as foam rubber, or the like. In FIG. **6**A, the lower shoot bolt **13** and seal block **61** are shown in their retracted positions relative to a guide **63** and body **12**. In this retracted position, the lower end of the lower shoot bolt **16** does not extend a substantial distance below the lower end of the body **12**, and is not engaged in an aligned bolt cup **303** in an underlying sill **300** of a door frame. As the shoot bolt actuator **22** (shown in FIGS. **1**, **2** and **2**B) is manually actuated, the lower actuator link **13** pushes downward on the push sleeve **65**, and causes the push sleeve **65** to translate downward relative to the guide **63** and body **12**. The downward translating push sleeve **65** pushes against a first spring **157** which pushes against an upper spring stop **69**, thus causing the upper spring stop **69** and shoot bolt **16** to move downward. As the shoot bolt **16** moves downward, the lower spring stop **169** pushes on the second spring **167** which pushes on the lower seal block **61**, thus causing downward translation of the seal block **61**. As shown in FIG. **6**B, downward translation of the seal block **61** continues until the seal **163** contacts the underlying sill **300**. In this position, the lower end of the lower shoot bolt **16** is proximate to the aligned bolt cup **303** in the sill **300**.

As shown in FIGS. **6**C and **6**D, as the push sleeve **65** and shoot bolt **16** continue to translate downward, the lower end of the shoot bolt **16** extends past the seal **163** and is received within the aligned bolt cup **303** in the sill **300**. At this point, the first spring **157** is partially compressed, and biases the shoot bolt **16** toward its locked position. In addition, further downward movement of the second push fitting **69** acts to compress the second spring **167** against the slider **61**, thereby

biasing the slider **61** and seal **163** against the sill **300**. The preloaded seal **163** can prevent moisture from entering any gap that exists beneath a lower portion of an associated active door panel **100** and a lower end of the astragal **10**. Both the first and second springs **157**, **167** are at their minimum compressed lengths and exert maximum forces when the shoot bolts **14**, **16** and slider **61** are fully extended. The springs **157**, **167** permit the length of travel of the seal block **61** and shoot bolt **13** to vary in order to accommodate differences in configuration between installations. Reversing the shoot bolt actuator **22** causes the lower shoot bolt **16** and lower seal block **61** to disengage from the sill **300** and bolt cup **303**.

The upper shoot bolt assembly **50** can be simultaneously actuated by the shoot bolt actuator **22** and upper actuator link **11** (see FIG. **2**), and can operate substantially identically to the lower shoot bolt assembly **60** described above. The upper shoot bolt **14** can engage an aligned opening in a bolt plate affixed to an overlying header (not shown), for example. When the upper and lower shoot bolts **14**, **16** are extended and are engaged in respective openings in a doorframe, the bolts **14**, **16** fix an inactive door panel **200** to which the astragal **10** is attached in a closed position within the doorframe.

FIGS. **7** and **8** show one embodiment of a multi-point latch actuator assembly **40** for use in a multi-point locking astragal **10**. In this embodiment, the actuator assembly **40** can include a base **42** and a cam follower **48**. The cam follower **48** can be slidably disposed on or within the base **42**. An actuator spring **41** can be disposed between the base **42** and the cam follower **48**. The base **42** can include an opening **44** configured to receive an aligned deadbolt from a cooperating active door panel (not shown). A cam **46** can be pivotally connected to the base **42**, such as in slots **45**, and can be at least partially disposed within the opening **44**. Rotation of the cam **46** causes sliding movement of the cam follower **48** on the base **42**, and compression of the actuator spring **41**. The cam **46** can be configured and positioned in the opening **44** such that when a deadbolt is received in the opening **44**, the deadbolt forces the cam **46** to upwardly rotate, which causes vertical sliding movement of the cam follower **48**. The cam follower **48** is operably connected to the push rod **25** shown in FIG. **2**B. Accordingly, insertion of a deadbolt into the opening **44** results in associated vertical movement of both the cam follower **48** and the push rod **25**.

Operation of the multi-point latches **24**, **26** is illustrated schematically in FIGS. **9**A-**10**B. In FIGS. **9**A and **9**B, the upper multi-point latch **24** is pivotally disposed in an astragal housing **12**. As described above, the upper and lower latches **24**, **26** can be pivotally mounted within openings **52** in the shoot bolt actuator assemblies **50**, **60** of an astragal **10**. In the embodiment shown, the latch **24** pivots about a vertical axis that is parallel to the longitudinal axis of the astragal **10**. An actuator cam **46** is pivotally disposed within an opening **44** that aligns with a deadbolt **104** in a cooperating active door panel. A cam follower **48** is movably disposed proximate to the cam **46**, and is operably connected to a push rod **25**. A spring **41** biases the cam follower **48** in a downward position. A latch actuation member **47** on an upper end of the push rod **25** is positioned proximate to the latch **24**. As shown in FIG. **9**B, when the latch **24** is in a retracted position, substantially no portion of the latch **24** outwardly extends from the astragal **10**, and the latch **24** is not engaged with an adjacent keeper pawl **92** of a keeper **90** on a cooperating active door panel **100**.

As shown in FIGS. **10**A and **10**B, when the deadbolt **104** is received in the opening **44** and displaces the cam **46**, the cam follower **48**, push rod **25** and latch actuation member **47** are pushed upward by the cam **46**. Upward movement of the latch actuation member **47** causes rotation of the latch pawl **24**, thus causing the latch pawl **24** to outwardly extend from the astragal **10**. When outwardly extended, the latch pawl **24** engages the keeper pawl **92** of the aligned keeper **90** on the adjacent active door panel **100**, and blocks movement of the active panel **100** relative to the astragal **10**. The lower multi-point latch **26** shown in FIG. **1** can operate similarly to and simultaneously with the upper latch **24**. Accordingly, when a deadbolt **104** of a cooperating active door panel **100** is received in the astragal **10**, the active door panel **100** is engaged with the astragal **10** at multiple points along its length, including at the deadbolt **104**, at the upper latch **24**, and at the lower latch **26**. Conversely, when the deadbolt **104** is extracted from the opening **44**, the spring **41** causes the cam follower **48**, push rod **25** and latch actuation member **47**, latch **24** and cam **46** to return to the unlocked positions shown in FIGS. **9**A and **9**B.

Operation of the multi-point latches **24**, **26** is further illustrated in FIGS. **11**A and **11**B. In FIG. **11**A, an upper latch pawl **24** is rotatably connected to an upper shoot bolt **16**. Alternatively, the latch pawl can be otherwise rotatably mounted within the body **12**. The latch pawl **24** is shown in a retracted unlocked position in FIG. **11**A. In this position, a catch portion **73** of the latch pawl **24** is positioned proximate to an aperture **124** in the body **12**. Preferably, the catch portion **73** is fully recessed within the aperture **124** or does not protrude from the aperture **124** a substantial distance when the latch pawl **24** is in its retracted position. A first cam surface **49** of a latch actuation member **47** is positioned below and proximate to the upper latch pawl **24**. A resilient member **79** contacts a portion of the latch pawl **24**. A resilient seal **19** provides a weather-resistant seal between the active door panel **100** and the astragal **10** when the active door panel **100** is shut. A latch keeper **90** is installed along the inside vertical edge **102** of an associated active door panel **100** such that the latch keeper **90** is proximate to the aperture **124** in the body **12** when the active door panel **100** is closed against the astragal.

Upward movement of the latch actuation member **47** causes the first cam surface **49** to contact the latch pawl **24** and forces the latch pawl **24** to pivot to the extended or locked position shown in FIG. **11**B. As described above, such upward movement of the latch actuation member **47** results when a deadbolt **104** is received by the latch actuator assembly **40**. In the locked position, the catch portion **73** of the latch pawl **24** outwardly extends from the aperture **124**. In this locked position, retraction of the latch pawl **24** is blocked by the latch actuation member **47** which is positioned immediately behind the latch pawl **24**. As can be seen by comparing FIGS. **11**A and **11**B, the resilient member **79** is displaced by the latch pawl **24** as the latch pawl **24** moves from its retracted unlocked position to its extended locked position. When extended, the catch portion **73** engages the latch keeper **90**, thereby preventing the active door panel **100** from being opened. Retraction of the deadbolt **104** from the latch actuator assembly **40** causes downward movement of the latch actuation member **47** away from the latch pawl. Once the latch actuation member **47** is disengaged from the latch pawl **24**, the resilient member **79** forces the latch pawl **24** to pivot back to the retracted or unlocked position shown in FIG. **11**A. Once the deadbolt **104** and latch pawl **24** are retracted, the catch portion **73** is disengaged from the latch keeper **90**, and the active door panel **100** is free to open. The lower latch pawl **26** can be configured to be moved between its locked and unlocked positions in the same manner or a substantially similar manner.

One embodiment of a latch actuation member **47** is shown in FIG. **12**. The latch actuation member **47** can include a first portion **83** and second portion **85** connected by a coupling **87**

and separated by a void **81** in between. The first portion **83** can include a first cam surface **49**, and the second portion **85** can include an opposed cam surface **89**. Accordingly, the first portion **83** and the second portion **85** can be mirror images of each other. The latch actuation member **47** can be configured to cooperate with a latch pawl **24**, **26** like that shown in FIG. **13**. The latch pawl **24**, **26** can include a body **71** having a catch portion **73**, a heel **77**, and a pawl cam surface **43**. The body **71** can be connected to a pivot mount **75**.

FIG. **14** shows the upper latch pawl **24** engaged with the latch actuation member **47** on the upper end of the push rod **25**. The latch pawl **24** is shown in a retracted position. The body **71** of the latch pawl **24** can be disposed within the void **81** between the first portion **83** and the second portion **85** of the latch actuation member **47**. In this position, the pawl cam surface **43** on the pawl **24** and the first cam surface **49** on the latch actuation member **47** can be proximate to each other. Upward movement of the latch actuation member **47** can cause the first cam surface **49** to push against the pawl cam surface **43** such that the body **71** of the pawl **24** is wedged out of the void **81**, and to rotate to its locked position. Conversely, downward movement of the latch actuation member **47** can realign the pawl **24** with the void **81**, and can permit the body portion **71** of the pawl **24** to retract to its unlocked position within the void **81**. The lower latch pawl **26** and lower latch actuation member **47** can be similarly configured. The symmetry of the first and second portions **83**, **85** permits identical latch actuation members **47** to be used on both the top and bottom ends of the push rod **25**.

One embodiment of a keeper **90** for use with a multipoint locking system that includes a multi-point latch **24**, **26** that pivots about a vertical axis is shown in FIGS. **15-17**. In this embodiment, the keeper **90** can include a keeper base **96** with an opening **98**. A keeper pawl **92** can be pivotally disposed in the opening **98** such that the keeper pawl **92** can reside within the opening **98** or can outwardly extend from the opening **98**. As shown in FIG. **17**, the keeper pawl **92** can snap into a mating recess **91** in the keeper base **96**. A spring **94** can bias the keeper pawl **92** away from the base **96** and opening **98** and cause the keeper pawl **92** to outwardly extend from the base **96** and opening **98** in a free state. As shown in FIGS. **15-17**, the spring **94** can be a leaf spring, and can be anchored in a slot **95** in the base **96**.

As shown in FIGS. **11**A and **11**B, the spring-biased keeper pawl **92** can outwardly extend from the edge of a cooperating active door panel **100** such that the keeper pawl **92** extends across a gap between the astragal **10** and the active panel **100**, and contacts the adjacent astragal **10**. Because the spring **94** pushes the keeper pawl **92** toward the astragal **10**, contact between the keeper pawl **92** and astragal **10** can occur though there may be substantial variation in the width of the gap between the door panel **100** and the astragal **10** from one installation to another. Accordingly, the keeper **90** can be self-adjusting. In addition, because the keeper pawl **92** can always be positioned against the astragal **10**, the likelihood that the catch portion **73** of an associated latch pawl **24**, **26** will engage the keeper pawl **92** when the rotating latch pawl **24**, **26** extends outward from the astragal **10** is maximized. Furthermore, because the keeper pawl **92** can pivot about a vertical axis, an extended keeper pawl **92** can deflect inwardly (i.e., toward the inactive panel **200**) as an active panel **100** is closed against an adjacent astragal **10**. Therefore, the keeper pawl **92** will not catch on the astragal **10** as the active panel **100** closes. In addition, contact with a portion of an adjacent astragal **10** can reinforce the keeper pawl **92** when forces tending to pull the pawl **92** away from the keeper **90** are exerted on the pawl **92** by an engaged latch **24**, **26**.

Another embodiment of a keeper **190** for use with a multipoint locking system that includes a multi-point latch **24**, **26** that pivots about a vertical axis is shown in FIGS. **18-21**. In this embodiment, the keeper **190** can include a keeper base **196**, a pawl support **197**, and a keeper pawl **192** pivotally mounted to the pawl support **197**. As shown in FIG. **20**, the pawl support **197** is received in a cavity in the keeper base **196**. As shown in FIGS. **18**, **19** and **21**, when the pawl support is received in the keeper base **196**, the keeper pawl **192** outwardly and movably extends from the base **196**. As seen best in FIG. **21**, the pawl support **197** can include a first magnet **199** and the keeper pawl **192** can include a second magnet **191**. The magnets **199**, **191** are arranged such that like poles of each magnet face each other. Accordingly, the magnets **199**, **191** repel each other, and bias the pivoting keeper pawl **192** away from the base **196**. When the keeper **190** is installed along the non-hinged edge of a door panel **100** as shown in FIGS. **11**A and **11**B, the magnets **199**, **191** (not shown in FIG. **11**A or **11**B) urge the keeper pawl **192** away from the door panel **100** and toward an opposed door panel **200**. Accordingly, the keeper pawl **192** can outwardly extend from the edge of a cooperating active door panel **100** such that the keeper pawl **192** extends across a gap between the an astragal **10** and the active panel **100**, and contacts the adjacent astragal **10**. Because the magnets **199**, **191** push the keeper pawl **92** toward the astragal **10**, contact between the keeper pawl **192** and astragal **10** can occur though there may be substantial variation in the width of the gap between the door panel **100** and the astragal **10** from one installation to another. Accordingly, the keeper **190** can be self-adjusting. In addition, because the keeper pawl **192** can always be positioned against the astragal **10**, the likelihood that the catch portion **73** of an associated latch pawl **24**, **26** will engage the keeper pawl **192** when the rotating latch pawl **24**, **26** extends outward from the astragal **10** is maximized. Furthermore, because the keeper pawl **192** can pivot about a vertical axis, an extended keeper pawl **192** can deflect inwardly (i.e., toward the inactive panel **200**) as an active panel **100** is closed against an adjacent astragal **10**. Therefore, the keeper pawl **192** will not catch on the astragal **10** as the active panel **100** closes. In addition, contact with a portion of an adjacent astragal **10** can reinforce the keeper pawl **192** when forces tending to pull the pawl **192** away from the keeper **190** are exerted on the pawl **192** by an engaged latch **24**, **26**.

The keeper **190** shown in FIGS. **18-20** also can be adjusted to optimally align the keeper pawl **192** with a latch pawl **24**, **26** in an opposing astragal **10**. As shown in FIG. **20**, the pawl support **197** is slidably received in the keeper base **196**. The depth that the pawl support **197** is inserted into the base can be selected such that the pivoting keeper pawl **192** is located at a desired position relative to the base **196**. As shown in FIG. **21**, the base **196** can include a first plurality of ridges **193**, and the pawl support **197** includes a cooperating second plurality of ridges **195**. When the pawl support **197** is inserted into the base to a desired depth and the keeper **196** is installed within a mating pocket within a door's edge, the ridges **193**, **195** are pressed together, and cooperate to prevent the pawl support **197** from moving within the base **196**. To adjust the alignment of the pawl support **197** in the base **196**, the keeper **190** can be removed from the pocket in the door, the pawl support **197** can be repositioned within the base **196**, and the keeper **190** can be reinstalled in the pocket in the door. Accordingly, the keeper **190** can be adjusted to correct any misalignment between the keeper pawl **192** and a latch pawl **24**, **26** in an opposing astragal **10**, and a slight lateral mislocation of a milled pocket in a door for receiving the keeper **190** can be accommodated.

As shown in FIG. **22**, a multi-point locking system **110** that is substantially similar to that described above for a multi-point locking astragal **10** can also be incorporated into an elongated vertical doorframe member **112** for use with a single door panel installation. The vertical frame member **112** can be a side jamb like that shown in FIG. **18**, or can be a mullion, for example. The vertical frame member **112** can include a stop **114** and a latch portion **117**. The vertical frame member **112** can be configured such that when the non-hinged vertical edge of an associated single door panel (not shown) is closed against the stop **114**, the non-hinged vertical edge of the door will be positioned immediately adjacent to the latch portion **117**. As shown in FIG. **22**, upper and lower pivoting latch pawls **124** and a latch actuator assembly **140** can by mounted along the latch portion **117**. A channel **125** can be provided in the latch portion **117** for receiving a pushrod (not shown) that operably couples the latch actuator assembly **140** to the latch pawls **124**. The latch actuator assembly **140** and latch pawls **124** can be substantially similar to the latch actuator assembly **40** and latch pawls **24**, **26** described above, for example. In addition, the latch pawls **124** can cooperate with latch actuation members **47** like those described above. The locking system **110** can be configured such that when a deadbolt is received in an opening **144** in the latch actuator assembly **140**, the upper and lower latch pawls **124** both outwardly pivot to their extended locking positions. Latch keepers **90** like those described above can be provided on the non-hinged vertical edge of a cooperating single door panel for engagement with the extended latch pawls **124**, thereby securing the door in a closed position against the vertical frame member **112**.

The above descriptions of preferred embodiments of the invention are intended to illustrate various aspects and features of the invention without limitation. Persons of ordinary skill in the art will recognize that certain changes and modifications can be made to the described embodiments without departing from the scope of the invention. For example, while the invention has been described for use with swinging door panels, a locking system according to the invention can also be applied to casement window panels and casement window frames, or the like. All such changes and modifications are intended to be within the scope of the appended claims.

What is claimed is:

1. An entryway comprising, a sill spanning a bottom of the entryway and having a lower bolt opening, a normally inactive door panel, a normally active door panel, and an astragal mounted to and extending along an unhinged edge of the normally inactive door panel, the astragal comprising:

an elongated body having opposite top and bottom;

a first shoot bolt at one end of the elongated body and being movable between a retracted position substantially withdrawn into the elongated body and an extended position projecting in an axial direction from the one end of the astragal;

a second shoot bolt at the opposite end of the elongated body and being movable between a retracted position substantially withdrawn into the elongated body and an extended position projecting in an axial direction from the opposite end of the astragal;

a seal block substantially surrounding the first shoot bolt and being movable between a non-sealing position substantially withdrawn into the elongated body and a sealing position projecting in an axial direction from the one end of the elongated body, the seal block having a bolt passage therethrough, the first shoot bolt being slidably disposed through the passage;

a shoot bolt actuator accessible on the elongated body and being movable between an unlocked position and a locked position, the shoot bolt actuator being linked through a plurality of actuator links to the first and second shoot bolts and to the seal block, the actuator links being configured upon movement of the shoot bolt actuator from its unlocked position toward its locked position to drive the seal block toward the sealing position until the seal block engages against the sill, to drive the first shoot bolt from the retracted position toward the extended position, and to drive the second shoot bolt from the retracted position toward the extended position;

a first spring configured to bias the first shoot bolt; and

a second spring configured to bias the seal block, wherein the second spring has a first length when the seal block is in the non-sealing position and the shoot bolt actuator is in the unlocked position, and

wherein the second spring has a second length when the seal block is in the sealing position engaged with the sill and the shoot bolt actuator is in the locked position, the first length being longer than the second length.

2. The entryway according to claim **1** wherein the shoot bolt actuator is configured to move both the first shoot bolt and the second shoot bolt from their retracted positions toward their extended positions substantially simultaneously.

3. The entryway according to claim **1** further comprising a plurality of spaced latch pawls disposed in the elongated body, each latch pawl being movable between an unlocked position substantially contained within the elongated body and a locked position projecting from the elongated body in a direction away from the unhinged edge of the inactive door panel.

4. The entryway according to claim **3** further comprising a latch actuator configured to move the spaced latch pawls between their unlocked positions and their locked positions substantially simultaneously.

5. The entryway according to claim **3** wherein the latch actuator includes a base having an opening configure to receive a deadbolt, the latch actuator is configured to move the spaced latch pawls from their unlocked positions to their locked positions as the deadbolt is received in the opening.

6. The entryway according to claim **3** wherein each latch pawl pivots about a vertical axis as the latch pawls move between their locked and unlocked positions.

7. The entryway according to claim **3** further comprising a plurality of latch keepers affixed along a non-hinged vertical edge of the normally active door panel such that each latch keeper vertically aligns with one of the latch pawls, and wherein each latch keeper includes a pivoting keeper pawl that outwardly extends from the non-hinged vertical edge of the active door panel.

8. The entryway according to claim **1**, wherein the actuator links are further configured such that continued movement of the shoot bolt actuator to its locked position compresses the first spring to apply a progressively increasing biasing force to the first shoot bolt, thereby biasing the first shoot bolt into engagement within the lower bolt opening.

9. The entryway according to claim **1**, wherein the first spring and the second spring are spaced apart along the body and coaxial with one another.

10. The entryway according to claim **1**, further comprising a resilient seal attached to a lower end of the seal block.

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